

Indo-US Collaboration on “Particle Accelerator Technology”

Particle Accelerator Technology has broad application in science. Applications have advanced our understanding of the universe, helped develop modern electronics, advanced medical research and treatments, and trained future scientists and engineers. Particle accelerators originally built by physicists to explore the fundamental nature of matter have now become ubiquitous tools for biomedical and material research. Higher intensity electron accelerators produce ever brighter “photon” beams that enable scientists to pursue research that: advances microelectronics; revolutionizes cell biology with a goal of understanding protein function as the engine of life; develops new pharmaceuticals; and allows the imaging of the pioneering nano-structures whose scale is measured in billionths of meter. These emerging technologies, such as the world’s first X-ray laser to be built at SLAC, promise to have far reaching impact on our economies, health, way of life, and standard of living.

Particle physics is a global science. Today’s most powerful particle accelerator, the Tevatron at Fermilab, has more than two thousand scientists, engineers, and students from around the world, including India, working together on a common mission to discover the mysteries of the universe. An even more powerful accelerator, The Large Hadron Collider (LHC) in Geneva Switzerland, will begin operation in 2007. Scientists from around the world, including the US and India, designed and built key components for the LHC machine and its experiments, paving the way for their participation in a decade of exciting discoveries.

The proposed next step in accelerators is to build an electron-positron linear collider using Superconducting Radio Frequency (SRF) technology; called the International Linear Collider (ILC), this accelerator will complement and expand the discovery reach of the LHC. The International Committee for Future Accelerators (ICFA) has strongly supported the development of international collaborations to carry out the R&D towards the design and construction of the ILC under the Global Design Effort (GDE). Fermilab is leading the US effort in the SRF technology R&D for the International Linear Collider. There are several possible international sites for the ILC, including Fermilab in the US and several sites in Asia and Europe.

The ILC SRF technology broadly expands the possibilities for ever more modern light sources as well as high intensity proton and neutron machines. The Euro-XFEL Project, to be located at the DESY Laboratory, Germany, will employ ILC SRF technology to provide high brightness, femto-second pulsed X-ray beams. Fermilab is developing a design for a high intensity proton machine using the SRF technology. This accelerator can also be used to produce high intensity X-rays or produce spallation neutron beams. Cornell University and Thomas Jefferson Laboratory are performing R&D for an “Energy Recovery Linac” (ERL) that uses the ILC SRF technology and will pave the way for the next generation of X-ray beams. The SRF cavity technology is also being considered for an upgrade to the Relativistic Heavy Ion Collider and development of small emittance beams.

The Indo-US collaboration on “Particle Accelerator Technology” will enable development of next generation particle accelerators in both countries for the advancement of basic and applied research and technology. This collaboration could also educate students, engineers and technicians to use the advanced technologies in universities, laboratories and industry.